



# The Quality of Plain and Flavored Greek Yogurt

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## ABSTRACT

**Background:** Despite the widespread consumption and economic significance of Greek yogurt, there are no universally recognized standards. This has resulted in variations in its nutritional composition, production methods, and labeling practices, leading to inconsistencies in quality across brands and markets. This study investigates the physicochemical, microbial, and sensory properties of plain and flavored Greek yogurts produced in Oman to address consumer preferences and establish quality benchmarks.

**Methods:** Physicochemical analyses were conducted to measure density, moisture, fat, protein, Ash, pH, acidity, total solids, non-fat solids, color and viscosity of plain and flavored Greek yogurts. Microbial assessments were performed to determine total viable counts, yeast and mold, *E. coli*, and *S. aureus*. While sensory evaluations were carried out to assess aroma, color, texture, flavor, acidity, sweetness, and overall acceptability.

**Result:** Flavored yogurts exhibited lower moisture content (71.69-72.32%) compared to plain yogurt (77.87%), contributing to a creamier texture. Fat content varied by flavor, with peach and apricot yogurt containing the highest level (5.475%), while plain yogurt had the highest protein content (2.35%). Flavored variants showed increased acidity (1.037-1.110%) and higher viscosity (32,965-34,400 cP), enhancing their sensory appeal. Microbial analyses confirmed the safety of all samples, with lower total viable counts in flavored yogurts attributed to the antimicrobial properties of fruit acids. Sensory evaluations revealed that strawberry yogurt was the most preferred, scoring highest in flavor, sweetness, and overall acceptability (93.3% acceptability index). These findings underscore the importance of optimizing sensory attributes and product formulations to improve consumer satisfaction in the dairy industry.

**Key words:** Microbial, Physicochemical, Sensory evaluation, Quality standards.

## INTRODUCTION

Greek yogurt, a strained yogurt variety, has become a staple in the global dairy market due to its unique combination of taste, texture and nutritional benefits. It is produced by removing excess whey through straining, resulting in a thicker consistency and higher protein content compared to regular yogurt (Sodini *et al.*, 2005). This nutritional profile has positioned Greek yogurt as a prominent component in health-focused diets and a versatile ingredient in both sweet and savory recipes. The global popularity of Greek yogurt has further been driven by increasing consumer awareness of its health benefits, particularly its high protein content, probiotics and lower sugar levels in plain formulations.

While plain Greek yogurt offers a nutrient-dense, low-calorie option, the demand for flavored variants has grown steadily in response to evolving consumer preferences. Flavored Greek yogurts, often enhanced with fruits, sweeteners and other additives, cater to diverse palates and have played a critical role in the expansion of the Greek yogurt market. However, the inclusion of flavoring agents and sweeteners—whether natural or artificial—raises important questions about the impact on the nutritional value, sensory attributes and overall quality of the product (Tunick and Van Hekken, 2016). Striking a balance between health appeal and consumer preference remains a critical challenge for yogurt manufacturers.

Quality assessment of Greek yogurt involves the analysis of its physicochemical properties, including

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texture, pH, acidity and microbial stability. The straining process not only enhances the protein content but also affects the yogurt's viscosity and water-holding capacity. The pH and acidity of Greek yogurt are also critical quality indicators. A pH range of 4.0-4.6 ensures the preservation of yogurt while providing its signature tangy flavor. However, flavored yogurts may experience pH changes due to the addition of sweeteners or fruit components, which can influence microbial activity and shelf life (Tamime and Robinson, 2007). Additionally, the incorporation of fruits or artificial flavoring agents may introduce variability in the yogurt's overall consistency and stability, necessitating careful formulation to achieve optimal quality.

Consumer preferences for Greek yogurt are shaped by broader trends in the food industry, including the

increasing demand for functional foods, natural ingredients and reduced-sugar formulations. Health-conscious consumers often gravitate toward plain Greek yogurt for its unadulterated nutritional profile, while flavored options appeal to those prioritizing taste and convenience. The rise of flavored Greek yogurt can also be attributed to innovations in product marketing and packaging. Individual-sized portions, often fortified with granola or fruit toppings, cater to on-the-go lifestyles and further enhance the product's appeal. These innovations demonstrate the importance of understanding consumer behavior and preferences in driving market success.

The sensory properties of Greek yogurt—texture, flavor, aroma and appearance, play a pivotal role in consumer acceptance. Plain Greek yogurt is known for its tangy taste and creamy texture, which appeals to health-conscious individuals seeking a low-calorie alternative to desserts or snacks. However, for many consumers, the tangy flavor of plain yogurt may be too intense, leading to the widespread incorporation of sweeteners and flavors to improve palatability (Guggisberg *et al.*, 2009). Flavored Greek yogurts offer diverse taste profiles that cater to broader consumer demographics, including children and individuals seeking indulgent dairy options. Popular flavors include fruit-based varieties such as strawberry, blueberry and mango, as well as dessert-inspired flavors like vanilla, chocolate and caramel. The challenge for manufacturers lies in maintaining the creamy texture and tangy base characteristic of Greek yogurt while ensuring that flavor additions do not overpower or compromise the product's quality.

Despite the widespread consumption and economic importance of Greek yogurt, there are no universally recognized standards, either internationally or regionally, that define the specific requirements for Greek yogurt. This lack of standardization has resulted in variations in its nutritional composition, production methods and labeling practices, leading to potential inconsistencies in quality across brands and markets. For instance, some products labeled as "Greek yogurt" may rely on thickeners rather than the traditional straining process to achieve the desired texture. This variability can confuse consumers and challenge regulatory oversight.

This study aims to provide valuable insights for yogurt manufacturers seeking to optimize product quality and align with consumer expectations. It establishes groundwork for developing standardized guidelines, ensuring consistency and quality for future production.

## MATERIALS AND METHODS

### Samples

Samples of plain Greek yogurt (PGY) and flavored Greek yogurt; Strawberry (SGY), Mango (MGY), Blueberry (BGY) and Peach and Apricot (PAGY) were supplied by Mazoon Dairy Company located in As'Sunainah, Oman, packed in polyethylene plastic cups with an aluminum seal. A total of 25 samples were collected, with 5 samples from each product. The samples were stored in the refrigerator at 5°C

until analysis. Each product was evaluated no later than 21 days before the expiration date.

### Physicochemical analyses

Physicochemical analyses for moisture, total solids, ash and acidity were conducted using the Association of Official Analytical Chemists methods (AOAC, 2012). The density of Greek yogurt samples was calculated by measuring the mass per unit volume (g/cm<sup>3</sup>). pH was measured using a pH meter (Mettler-Toledo, Schewezenbach, Switzerland). Protein content was estimated using the formol titration method described by James (1995), which relies on the measurement of the carboxylic group present in the amino acids and protein by titrating with 0.1 N NaOH. 10 g from each sample was diluted with 100 ml of deionized water and mixed thoroughly before initiating the titration method. Fat content was determined by the Gerber method as described in AOAC (2012). Carbohydrates were calculated by differences. The total caloric value was calculated by individual factors, 9 for lipids and 4 for protein and carbohydrates. Analyses were performed in triplicate.

### Color and viscosity measurement

The color of GY samples was measured by Chroma Metercr-410 (Konica Minolta, Japan) set on the L\* (lightness), a\* (redness) and b\* (yellowness) system according to Milovanovic *et al.* (2020). The viscosity of GY was measured using a Brookfield viscometer (Ametek, USA) with Spindle No. 4 at 3 rpm speed at 5°C.

### Microbial analyses

All media were obtained in dehydrated forms and were prepared according to the manufacturer's instructions. Plate count agar was used to determine the total viable count (Houghtby *et al.*, 1992). MacConkey agar was used to determine the *Escherichia coli* count and Mannitol salt agar was prepared for *Staphylococcus aureus* (Christen *et al.*, 1992). Potato dextrose agar was used to determine yeast and mold counts (Frank *et al.*, 1992). Sterile glassware such as Petri-dishes, test tubes, pipettes, flasks and bottles were used, whereas distilled water and tips were sterilized by autoclaving for 15 min at 121°C.

### Sensory evaluation

A descriptive sensory evaluation using a five-point hedonic scale test (1- dislike very much to 5- like very much) was used to evaluate sample acceptability (Gacula, 1997). A sensory assessment of samples was done after 1-2 days of cold storage at 5°C. The panelists (n = 22) were semi-trained members of the staff of the Natural and Medical Research Center (NMSRC), University of Nizwa. The samples were provided at 10°C. Each panelist was instructed to evaluate aroma, color, texture, flavor, acidity, sweetness and overall acceptability. Mineral water was available as a neutralizer between samples in order to avoid carryover effects.

The Acceptability Index (AI) was calculated as suggested by Dutcosky (2007), who classifies a product

with good acceptability when the mean values of sensory properties are greater than 70%. AI was calculated according to the Equation:

$$AI (\%) = M/h \times 100$$

Where

AI = Acceptability index.

M = Arithmetic mean of the scores assigned to the assessed characteristic.

h = Highest score attributed by the panelists to the assessed characteristic.

### Statistical analysis

The parameters data for Greek yogurt (GY) were analyzed in triplicate and the average and standard deviation were calculated using Excel. A significant difference (LSD) test was used to compare mean values at the 5% mark as a probability level using Excel 2016.

## RESULTS AND DISCUSSION

Greek yogurt has emerged as a staple in the dairy industry due to its higher protein content, creamy texture and versatility in flavoring. The increasing demand for both plain and flavored Greek yogurt necessitates an understanding of its physicochemical, microbial and sensory properties to ensure consumer satisfaction. This study explores these quality attributes in detail, comparing the results with findings from previous studies.

Table 1 presents the physicochemical characteristics of plain and flavored Greek yogurt. The density, total soluble solids (TSS), calories, carbohydrates and non-fat solids content of plain and flavored Greek yogurt varied significantly, as presented in Table 1. The density of the samples ranged from 1.059 g/cm<sup>3</sup> for plain yogurt to 1.103 g/cm<sup>3</sup> for mango yogurt, with flavored variants generally exhibiting higher densities due to their increased solid content. Similarly, TSS values were significantly higher in flavored yogurts (19.78-21.84%) compared to plain yogurt (12.23%), likely due to the addition of fruit purees and sweeteners. Caloric content followed a similar trend, with flavored yogurt

showing higher values (130.31-138.56 kcal/100 g) than plain yogurt (111.16 kcal/100 g), which can be attributed to the increased carbohydrate content in flavored samples (20.00-20.66%) compared to plain yogurt (13.99%).

Additionally, the SNF content was higher in flavored yogurts (22.75-23.44%) than in plain yogurt (17.04%), indicating the impact of added fruit components and stabilizers on the overall composition. These variations highlight the role of flavoring ingredients in modifying the physicochemical properties of Greek yogurt, contributing to differences in texture, sweetness and nutritional value.

### Moisture content

The moisture content of plain Greek yogurt (77.87%) was notably higher than that of flavored variants (71.69-72.32%). This reduction in moisture in flavored yogurts aligns with studies such as Hernández *et al.* (2022), which attributed lower moisture in flavored yogurts to the addition of solids like fruit purees or concentrates. Desai *et al.* (2013) similarly observed that commercial Greek yogurts with flavoring agents had reduced water activity due to their higher solid content (Desai *et al.*, 2013). Higher moisture in plain yogurt contributes to its lighter texture and slightly less dense mouthfeel compared to flavored variants. This property could make plain yogurt less appealing to consumers preferring creamier options, as noted in previous sensory studies (Desai *et al.*, 2013).

### Fat and protein content

Plain Greek yogurt had fat content of 5.089%, while flavored variants ranged from 4.301% (strawberry) to 5.475% (peach and apricot). The increase in fat content in peach and apricot yogurt can be attributed to the fruit blend's lipid composition. Similar trends were documented by Hernández *et al.* (2022), who noted variations in fat content based on flavoring ingredients. The Codex Alimentarius (2008) for fermented milk defines that yogurt should contain less than 15% fat and this agrees with the results of the present study.

Protein content in plain yogurt (2.35%) exceeded all the flavored variants (2.01-2.32%), aligning with studies

**Table 1:** The physiochemical characteristics of plain and flavored greek yogurt.

| Products                     | PlainGY                  | Strawberry GY            | MangoGY                  | Blueberry GY             | Peach and apricot GY     |
|------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Density (g/cm <sup>3</sup> ) | 1.059±0.020 <sup>a</sup> | 1.065±0.012 <sup>a</sup> | 1.103±0.024 <sup>a</sup> | 1.079±0.026 <sup>a</sup> | 1.082±0.009 <sup>a</sup> |
| Moisture (%)                 | 77.87±0.32 <sup>a</sup>  | 72.26±0.13 <sup>b</sup>  | 72.32±0.20 <sup>b</sup>  | 72.23±0.65 <sup>b</sup>  | 71.69±0.86 <sup>b</sup>  |
| Fat (%)                      | 5.089±0.004 <sup>a</sup> | 4.301±0.072 <sup>b</sup> | 4.934±0.249 <sup>c</sup> | 4.845±0.372 <sup>c</sup> | 5.475±0.238 <sup>d</sup> |
| Protein (%)                  | 2.35±0.13 <sup>a</sup>   | 2.24±0.10 <sup>a</sup>   | 2.13±0.11 <sup>a</sup>   | 2.01±0.02 <sup>b</sup>   | 2.32±0.09 <sup>a</sup>   |
| Ash (%)                      | 0.701±0.041 <sup>a</sup> | 0.538±0.040 <sup>b</sup> | 0.548±0.069 <sup>b</sup> | 0.502±0.027 <sup>c</sup> | 0.519±0.049 <sup>c</sup> |
| Carbohydrates (%)            | 13.99±0.12 <sup>a</sup>  | 20.66±0.09 <sup>b</sup>  | 20.07±0.16 <sup>b</sup>  | 20.41±0.27 <sup>b</sup>  | 20.00±0.31 <sup>b</sup>  |
| Calories (Kcal/100 g)        | 111.16 <sup>a</sup>      | 130.31 <sup>b</sup>      | 133.21 <sup>b</sup>      | 133.29 <sup>b</sup>      | 138.56 <sup>b</sup>      |
| pH                           | 4.70±0.00 <sup>a</sup>   | 4.51±0.01 <sup>a</sup>   | 4.49±0.01 <sup>a</sup>   | 4.42±0.01 <sup>a</sup>   | 4.43±0.01 <sup>a</sup>   |
| Acidity %                    | 1.307±0.045 <sup>a</sup> | 1.037±0.042 <sup>b</sup> | 1.083±0.045 <sup>b</sup> | 1.110±0.026 <sup>b</sup> | 1.083±0.046 <sup>b</sup> |
| Total soluble solids         | 12.23±0.35 <sup>a</sup>  | 19.78±0.51 <sup>b</sup>  | 21.84±0.39 <sup>c</sup>  | 20.60±0.84 <sup>c</sup>  | 21.18±1.04 <sup>c</sup>  |
| Total solids %               | 22.13±0.32 <sup>a</sup>  | 27.74±0.13 <sup>b</sup>  | 27.68±0.20 <sup>b</sup>  | 27.77±0.65 <sup>b</sup>  | 28.31±0.86 <sup>b</sup>  |
| Non-fat solids %             | 17.04±0.13 <sup>a</sup>  | 23.44±0.10 <sup>b</sup>  | 22.75±0.21 <sup>b</sup>  | 22.93±0.45 <sup>b</sup>  | 22.84±0.52 <sup>b</sup>  |

GY: stands for Greek Yogurt. Different letters in the same line are significantly different at p<0.05.

showing that flavor additions can dilute protein concentrations. Desai *et al.* (2013) observed that Greek yogurts enriched with flavors often experience a slight reduction in protein due to the lower proportion of concentrated dairy solids. A physicochemical comparison among seven commercial GY made with cow's milk showed an average of 3.66 and 3.27% of protein and lipids, respectively (Mileib-Vasconcelos *et al.*, 2012). However, all variants are notably below the typical protein levels for yogurt, as the international standard Codex Alimentarius (2008) recommends a minimum of 2.7% protein for yogurts made from cow milk. Pappa *et al.* (2024) reported the mean values of fat and protein in 108 GY was 0-10.8% and 3.29-10.05% respectively.

### pH and acidity

The pH values ranged from 4.42 to 4.70, with plain yogurt being the least acidic. The slight increase in acidity for flavored yogurts, particularly blueberry (pH 4.42), is consistent with studies highlighting the influence of fruit acids on yogurt's pH. For instance, Desai *et al.* (2013) reported similar acidity trends in berry-flavored yogurts, attributing it to the organic acids present in the fruit. Acidity plays a key role in flavor perception, as higher acidity levels can enhance tartness. Pappa *et al.* (2024) reported the mean pH values of 108 GY as 3.58-4.64. It is known that variations between studies in pH values can be due to variations in processing during yogurt manufacture, such as the time and the temperature of incubation (Moh *et al.*, 2017).

The acidity ranged from 1.037% for strawberry GY to 1.307% for plain GY. According to the Codex Alimentarius (2008) standards, a minimum acidity of 0.6% is necessary for yogurt, since at this percentage, the formation of the coagulum starts. The results of the present study are in agreement with this statement. Additionally, these values were in line with Pappa *et al.* (2024) values for acidity, which ranged from 0.79% to 2.07%. The characteristics of the starter culture, the level of acidity that is produced from the starter culture, a high temperature of yogurt incubation and a long period of incubation contribute to the acidity differences observed. Moreover, the level of acidity can affect consumers' preferences (Somer and Kilic, 2012).

### Ash and total solid contents

The ash content can provide useful information regarding the mineral content of elements that are important for the

formation of teeth, growth of bones and other functions of the body (Igbabul *et al.*, 2017). The ash content of all samples ranged from 0.502% for Blueberry GY to 0.701 for plain GY. Similar findings have been presented by Pappa *et al.* (2024), which ranged between 0.5-1.17%. However, higher values (1.48%) were found in strained yogurts from local Turkish markets by Somer and Kilic (2012).

The mean values of the total solid content of all samples ranged from 22.13% in plain GY to 28.31% in Peach and Apricot GY. These values are in line with Pappa *et al.* (2024) values which ranged between 10.75% to 25.18%. Moreover, higher values were reported by Somer and Kilic (2012). Variations in the total solid content of the strained yogurts could be due to many factors, such as the chemical composition of the milk used in the manufacture of yogurts and the time and temperature applied during production (Somer and Kilic, 2012). Milk fat and protein content were significant factors affecting total solids (Table 1).

### Color and viscosity

Table 2 presents the values of color and viscosity of plain and flavored GY. The flavoured Greek yogurt samples (Strawberry, Mango, Blueberry and Peach and Apricot) did not contain any added artificial colors. The natural color of the yogurt came from the fruit flavourings used in the products. The L\* value, indicating lightness, was highest in plain GY (68.1) and lowest in blueberry GY (50.9), reflecting the dark pigmentation of blueberries. Similarly, the a\* and b\* values varied significantly, with blueberry GY showing the highest redness (a\* = 6.3) and mango GY the most pronounced yellow hue (b\* = 14.1). These results align with findings from Desai *et al.* (2013) and Hernández *et al.* (2022), which showed how fruit pigments significantly influence yogurt's chromatic properties.

Pappa *et al.* (2024) reported different values for lightness, redness (greenness) and yellowness which were between 86.30 and 95.00, -3.13 and -0.02 and 4.75 and 14.30, respectively. This variation could be due to the different contents of fat and protein between the samples, as in general, the higher the protein content of milk, the greener the yogurt (Milovanovic *et al.*, 2020) and the yellowness is positively correlated with fat content (Frøst *et al.*, 2001).

A viscometer was used to evaluate the structure and flow properties of set and stirred yogurts, the viscosity values of samples ranged from 21,253 cP (plain GY) to 34,400 cP

**Table 2:** Color and viscosity of plain and flavored greek yogurt.

| Products              | Plain GY               | Strawberry GY          | Mango GY               | Blueberry GY            | Peach and apricot GY   |
|-----------------------|------------------------|------------------------|------------------------|-------------------------|------------------------|
| Color                 |                        |                        |                        |                         |                        |
| L                     | 68.1±0.9 <sup>a</sup>  | 59.8±3.2 <sup>b</sup>  | 63.8±0.6 <sup>c</sup>  | 50.9±0.5 <sup>d</sup>   | 64.4±0.4 <sup>c</sup>  |
| a                     | 0.35±0.06 <sup>a</sup> | 4.16±0.29 <sup>b</sup> | 0.32±0.02 <sup>a</sup> | 6.3±0.1 <sup>c</sup>    | 1.11±0.00 <sup>d</sup> |
| b                     | 7.7±0.1 <sup>a</sup>   | 5.2±0.2 <sup>b</sup>   | 14.1±0.1 <sup>c</sup>  | -0.45±0.01 <sup>d</sup> | 12.7±0.1 <sup>e</sup>  |
| Viscosity (cP) at 5°C | 21253±133 <sup>a</sup> | 34400±820 <sup>b</sup> | 33810±771 <sup>b</sup> | 32995±870 <sup>b</sup>  | 32965±361 <sup>b</sup> |

Different letters in the same line are significantly different at p<0.05.



(strawberry GY), indicating a significant increase in flavored yogurts. These values are in line with the values reported by Skriver *et al.* (1993), which ranged between 12,000 and 40,000 cP. This enhancement is consistent with Desai *et al.* (2013), who found that fruit additions and stabilizers like pectin increase yogurt thickness. High viscosity correlates with consumer preferences for creaminess, as noted in sensory studies (Escalona *et al.*, 2022). The combination of vibrant color and enhanced viscosity likely contributes to the higher sensory scores for flavored yogurts, particularly strawberry GY and peach and apricot GY.

### Microbial quality

The Microbiological Criteria for Foodstuffs standard (GSO 1016, 2015) set the permissible limits of microbial in yogurt for yeast and mold, *E. coli* and *S. aureus*, which should not exceed 2, 0 and 2 Log CFU/g, respectively. The microbial values in GY samples presented in Table 3 showed TVC ranged between 2.40-5.31 Log CFU/g, Yeast and Mold ranged between 2.49-5.03 Log CFU/g and *S. aureus* ranged between 0-1.62 Log CFU/g. There was no presence of *E. coli* in any of the evaluated samples, confirming the safety of the yogurts. Total viable counts (TVC) were highest in plain yogurt (5.31 Log CFU/g), with flavored variants showing lower counts. This reduction in microbial counts may result from the antimicrobial properties of certain fruit acids and additives, as observed in studies by Escalona *et al.* (2022). Yeast and mold counts were within acceptable ranges, although slightly higher in strawberry and mango yogurts. Similar trends were reported by Desai *et al.* (2013), emphasizing the need for stringent quality control during flavoring processes.

### Sensory evaluation

Table 4 presents the sensory evaluation of plain and Flavored GY samples. Mango GY received the highest

aroma (4.10) and the highest flavor (4.36) for strawberry GY, which was followed closely by mango GY (4.28). These findings reflect consumer preferences for sweet and fruity profiles, as documented by Desai *et al.* (2013), where strawberries consistently ranked as the most preferred flavor. Plain GY excelled in texture (4.10), attributed to its firmer and denser consistency. Plain yogurt had a firmer and denser texture despite its lower total solids (TS%) because of its higher protein content and absence of added fruit components. Protein plays a crucial role in the structural integrity and gel formation of yogurt, contributing to firmness and thickness. In contrast, flavored yogurts, although higher in total solids due to added fruit purees and sweeteners, have a softer texture because fruit components can interfere with the protein network, reducing gel strength. Additionally, certain fruit ingredients contain enzymes or acids that may weaken the yogurt's structure, leading to a less dense consistency despite the higher TS%.

However, strawberry GY achieved higher scores in overall acceptability due to their enhanced viscosity and smoothness. Previous studies support this, noting that consumers favor thicker yogurts with minimal graininess (Escalona *et al.*, 2022).

Fig 1 presents a radar chart of flavored GY sensory attributes. The sensory evaluation of flavored GY revealed Strawberry GY as the most preferred product, excelling in flavor (4.36), sweetness (3.97) and overall acceptability (4.20), aligning with findings from previous studies emphasizing the consumer preference for sweet and flavorful dairy products. Mango GY followed closely, particularly in aroma (4.10) and color (3.87), reflecting its vibrant sensory appeal. Conversely, Peach and Apricot GY was the least preferred (3.30 in overall acceptability), likely due to its lower acidity (3.09) and flavor (3.55), which is consistent with studies suggesting that balanced acidity

**Table 3:** Microbial count (LogCFU/g) of plain and flavored greek yogurt.

| Products         | Plain GY               | Strawberry GY          | Mango GY               | Blueberry GY           | Peach and apricot GY   |
|------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| TVC              | 5.31±0.01 <sup>a</sup> | 3.67±0.11 <sup>b</sup> | 2.91±0.02 <sup>c</sup> | 2.93±0.02 <sup>c</sup> | 2.40±0.14 <sup>d</sup> |
| Yeast and Mold   | 5.03±0.01 <sup>a</sup> | 3.60±0.01 <sup>b</sup> | 2.81±0.01 <sup>c</sup> | 2.49±0.06 <sup>d</sup> | 3.18±0.02 <sup>e</sup> |
| <i>E. coli</i>   | ND                     | ND                     | ND                     | ND                     | ND                     |
| <i>S. aureus</i> | 1.62±0.03 <sup>a</sup> | 1.33±0.05 <sup>b</sup> | 1.59±0.04 <sup>a</sup> | 0.00±0 <sup>c</sup>    | 1.32±0.03 <sup>b</sup> |

TVC = Total viable count, ND = Not detected. Different letters in the same line are significantly different at p<0.05.

**Table 4:** Sensory evaluation of plain and flavored greek yogurt products.

|                       | Plain GY               | Strawberry GY          | Mango GY               | Blueberry GY           | Peach and apricot GY   |
|-----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Aroma                 | 3.63±0.55 <sup>a</sup> | 3.86±0.32 <sup>b</sup> | 4.10±0.19 <sup>c</sup> | 3.49±0.38 <sup>a</sup> | 3.62±0.07 <sup>a</sup> |
| Color                 | 3.34±0.48 <sup>a</sup> | 3.40±0.27 <sup>a</sup> | 3.87±0.23 <sup>b</sup> | 3.68±0.43 <sup>b</sup> | 3.75±0.35 <sup>b</sup> |
| Texture               | 4.10±0.73 <sup>a</sup> | 3.98±0.42 <sup>a</sup> | 3.90±0.26 <sup>a</sup> | 3.79±0.36 <sup>a</sup> | 3.70±0.10 <sup>a</sup> |
| Flavor                | 3.41±0.65 <sup>a</sup> | 4.36±0.07 <sup>b</sup> | 4.28±0.24 <sup>b</sup> | 3.67±0.25 <sup>c</sup> | 3.55±0.28 <sup>c</sup> |
| Acidity               | 3.74±0.63 <sup>a</sup> | 3.80±0.26 <sup>a</sup> | 3.81±0.61 <sup>a</sup> | 3.23±0.05 <sup>b</sup> | 3.09±0.44 <sup>c</sup> |
| Sweetness             | 3.05±0.83 <sup>a</sup> | 3.97±0.45 <sup>b</sup> | 3.61±0.80 <sup>c</sup> | 3.39±0.19 <sup>d</sup> | 3.47±0.33 <sup>d</sup> |
| Overall acceptability | 3.72±0.55 <sup>a</sup> | 4.20±0.20 <sup>b</sup> | 4.11±0.28 <sup>b</sup> | 3.59±0.02 <sup>a</sup> | 3.30±0.17 <sup>c</sup> |

GY: Greek Yogurt, Score: 1- dislike very much to 5- like very much. Different letters in the same line are significantly different at p<0.05.

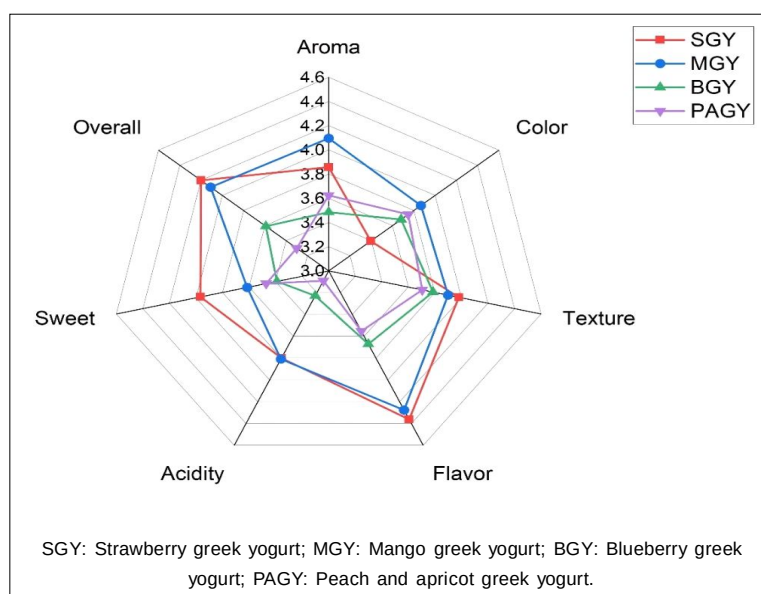


Fig 1: Radar chart of flavored greek yogurt sensory attributes.

Table 5: Acceptability Index (%) of plain and flavored greek yogurt products.

| Products              | Plain GY          | Strawberry GY     | Mango GY          | Blueberry GY      | Peach and apricot GY |
|-----------------------|-------------------|-------------------|-------------------|-------------------|----------------------|
| Aroma                 | 72.6 <sup>a</sup> | 96.4 <sup>b</sup> | 81.9 <sup>c</sup> | 69.7 <sup>a</sup> | 72.5 <sup>a</sup>    |
| Color                 | 66.8 <sup>a</sup> | 84.9 <sup>b</sup> | 77.3 <sup>c</sup> | 73.6 <sup>c</sup> | 75.0 <sup>c</sup>    |
| Texture               | 82.0 <sup>a</sup> | 79.6 <sup>a</sup> | 78.0 <sup>a</sup> | 75.7 <sup>a</sup> | 92.6 <sup>b</sup>    |
| Flavor                | 68.2 <sup>a</sup> | 87.2 <sup>b</sup> | 85.5 <sup>b</sup> | 73.4 <sup>c</sup> | 71.0 <sup>c</sup>    |
| Acidity               | 74.8 <sup>a</sup> | 76.0 <sup>a</sup> | 76.2 <sup>a</sup> | 80.7 <sup>b</sup> | 77.3 <sup>a</sup>    |
| Sweetness             | 61.0 <sup>a</sup> | 79.3 <sup>b</sup> | 72.3 <sup>c</sup> | 67.8 <sup>d</sup> | 69.4 <sup>d</sup>    |
| Overall acceptability | 74.4 <sup>a</sup> | 93.3 <sup>b</sup> | 82.2 <sup>c</sup> | 89.8 <sup>c</sup> | 66.0 <sup>d</sup>    |

Different letters in the same line are significantly different at  $p < 0.05$ .

and intense flavor are critical to yogurt's sensory success. These findings reinforce the importance of optimizing sensory attributes, particularly sweetness and flavor intensity, to align with broader market trends reported in similar studies.

Table 5 presents the acceptability index (%) of plain and flavored GY samples. The acceptability index (%) highlights strawberry GY as the most favored variant (93.3%), followed by blueberry GY (89.8%) and plain GY (74.4%). The high AI for flavored yogurts indicates a strong consumer preference for enhanced taste and creaminess, providing manufacturers with a clear direction for product development. The lower AI for plain GY reflects its simpler sensory profile, which appeals less to flavor-oriented consumers. These results align with studies showing that flavor, sweetness and aroma are key drivers of consumer liking (Viquez-Barrantes *et al.*, 2023).

This study underscores the significant impact of physicochemical, microbial and sensory attributes on the quality and consumer acceptance of GY. Plain GY exhibited higher moisture content and protein levels but scored lower in overall sensory acceptability due to its simpler flavour

profile. Conversely, flavoured variants, particularly strawberry and mango, were highly preferred, excelling in attributes like flavour, sweetness and aroma, which are critical to consumer liking. The physicochemical analyses revealed that flavour additions influenced properties such as acidity, viscosity and total solids, contributing to enhanced creaminess and texture in flavoured yogurts. Microbial evaluations confirmed the safety of all samples, with flavoured yogurts demonstrating slightly reduced microbial counts due to fruit additives' antimicrobial properties.

## CONCLUSION

The results align with previous studies emphasizing the preference for creamy, flavourful yogurts, suggesting that manufacturers can enhance acceptability by optimizing sensory attributes like sweetness and flavour intensity. While plain GY appeals to health-conscious consumers due to its higher protein and lower sweetness, developing new flavouring strategies for such variants could broaden their market appeal. Ultimately, this study provides valuable insights for tailoring GY products to meet diverse consumer preferences while maintaining quality standards.

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## Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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